The Citrus Industry

Commissioner of Agriculture Nathan Mayo joins Queen Nance Stilley in sampling a delicious Florida orange at the Florida Citrus Exposition. The 24th Annual Florida Citrus Exposition opens in Winter Haven February 16th for a six day run.

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Vol. 30, No. 2 February, 1948

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Florida's Great Citrus Exposition

The twenty-fourth annual Florida Citrus Exposition will open at Winter Haven on February 16th for a six day run during which 200 thousand visitors are expected through the gates.

Special days have been designated as follows:

Monday, Feb. 16 — Children's and Queen's Contest Day.

Tuesday, Feb. 17 — Coronation, Canner's and Associated Industries Day.

Wednesday, Feb. 18 — Mayo and Fruitman's Day.

Thursday, Feb. 19 — Tourist, Fraternal and Civic Organization Day.

Friday, Feb. 20 — Governor's and Press Day.

Saturday, Feb. 21 — Shrine Day.

Two daily broadcasts of coast-to-coast radio shows will emanate from the new permanent amphitheatre on the shores of Lake Silver. It is conservately estimated that 50 million people will listen to these broadcasts which will devote considerable time to lauding Florida citrus.

On Wednesday the annual Fruitman's Day Dinner will be held at the Winter Haven Armory to which citrus people from all over the state will be invited. Attendance is expected to equal that of past years, which has always been capacity.

Commissioner of Agriculture Nathan Mayo will attend on Wednesday and receive the honors due to one who has contributed so much to the citrus industry and Florida agriculture.

Governor Millard F. Caldwell will visit the Exposition on Friday along with members of the Florida Fourth Estate. The day will end with the annual Press Breakfast, which this year will return to the Haven Hotel, its original home for many years.

General Manager Philip E. Lucey reports that the citrus displays will be bigger and more numerous than ever this year. The buldings set aside for citrus displays are rapidly being filled and the decorators and painters are creating new and outstanding exhibitions of their art.

All indications point to an even greater Exposition than last year and officials of the show are preparing to entertain a record crowd.

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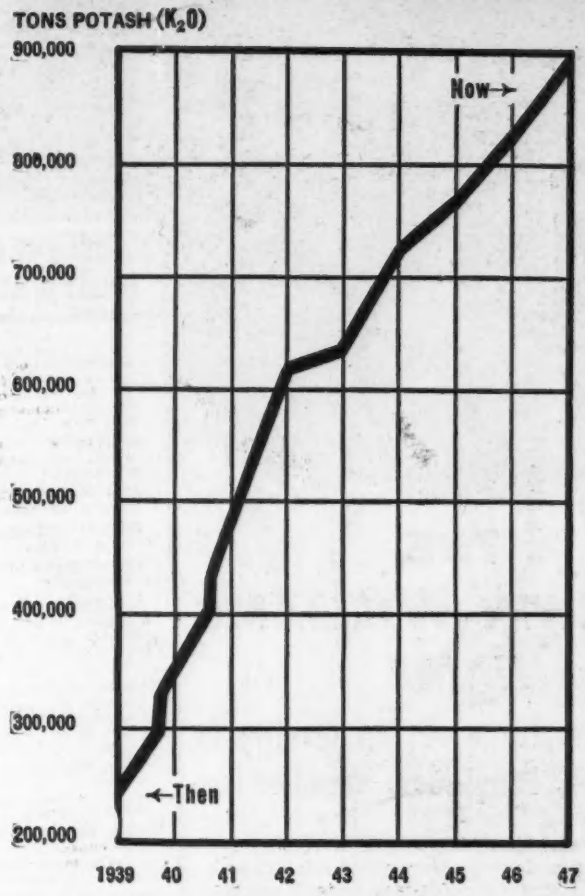

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Decay Of Florida Citrus Fruits And Its Control 1/ . . .

by J. R. Winston

In the shipment of fresh citrus fruit from Florida, decay is a factor that must be given serious consideration. At times the rate of spoilage is great; at other times it is almost negligible. Before discussing the most feasible methods of preventing decay, a review of the habits of the fungi principally concerned in causing spoilage may refresh your memories on this important economic subject.

Four fungi cause almost all of the decay in Florida citrus fruit, and for practical purposes they can be placed in two groups: the stem-end rots and the mold rots. Stem-end rot is caused by either of two fungi, **Diplodia natalensis** or **Phomopsis citri.** The latter also causes melanose. The mold rots, most commonly referred to as "blue mold" are caused by two species of Penicillium, namely, **P. digitatum** and **P. italicum.** The former is the one most commonly seen on Florida citrus fruits. Since the spore masses of this fungus are olive green in color, and those of **P. italicum** are sky blue, the names of green mold and blue mold are used to differentiate the organism.

The growth habits of the stem-end rot fungi and those causing the mold rots are vastly different. The stem-end rot fungi live. develop, and produce spores only in dead or dying wood such as dead twigs. Then by dew drip, or in rainy weather by rain spatter, spores are dispersed and lodge on nearby fruit, becoming attached to the stem parts if not acually penetrating them, and remaining in a quiescent state until the fruit is harvested. Soon after harvest these fungi become active and invade the fruit proper, usually through the stem parts. For practical purposes if the fruit is not infected with either of these stem-end rot fungi at time of harvest, it will not become infected later because the organisms are not air-borne to an extent that is of practical importance. Spores of the stem-end rot fungi are not commonly produced on decaying fruit.

The optimum temperature for the development of the Diplodia fungus, which causes most of the stem-end rot in fruit during fall and early winter, is about 86 degrees F. This is the temperature at which most coloring rooms are maintained and the bulk of the orange crop is subjected to regreening gases during this period. This fungus grows very rapidly at temperatures in the middle 80's but is completely checked at a temperature of 50 degrees or lower.

Phomopsis causes most of the stem-end rot encountered in late winter and spring. The optimum temperature for the development of this slower growing fungus is about 73 degrees F. A lower temperature is required to check it than to stop Diplodia. All citrus fruit becomes progressively more susceptible to stem-end rot as the ripening season advances.

The gas treatment, given to "color" or degreen citrus, renders such fruit most susceptible to rapid spoilage from stem-end rot, especially that caused by the fast-growing Diplodia fungus.

Spores of the green and blue molds are produced in limitless numbers on fallen fruit in groves and on rotting fruit around the packing house, in warehouses, etc., mainly during the cooler months. These spores are light and so easily carried in the normal air currents that they are omnipresent.

Green mold is almost always a

1/ By J. R. Winston, senior horticulturist, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, United States Department of Agriculture.

wound parasite and practically never invades fruit except through some recently made rupture in the rind. Blue mold enters the fruit most often through injured places but can spread from one fruit to another by contact, apparently through the uninjured skin. It is often called the blue contact mold. Infection of normal fruit by either of these molds rarely occurs while the fruit is on the tree. Clipper cuts, torn skin from "pulling," scratches, and box bruises or abrasions, wherever made, afford a ready entrance for these fungi which are so prevalent that infection is very likely to occur under the favorable temperature and humidity conditions that commonly prevail during the shipping season. Green mold is much more common than blue mold, not only here in Florida but also on the market.

Both of these molds make their best growth at about 75 degrees F. At this temperature they can grow about as rapidly as Diplodia at its optimum temperature. A satisfactory checking of mold growth occurs when fruit is held at 50 degrees, but at temperatures in the low thirties which more completely inhibit green mold, blue mold can develop very slowly. Other factors being the same, the higher the humidity, the speedier the spoilage because relatively high humidity promotes rapid germination of these spores and the development of decay.

Although the green and blue molds cause their greatest financial losses during the winter months, these fungi are more likely to develop on fully ripe fruit than on less mature fruit. Probably the rind of ripe fruit is more easily ruptured than that of less mature fruit. After an injury has occurred in damp weather mold rot is almost certain to develop. In really dry weather minor rind injuries are not quite so serious. Thus it is obvious that if rind injuries are prevented the mold rots will be of no consequence. That thought is not new. The Chinese fully 2,000 years ago recognized the importance of careful handling as a means of prevention of the mold rots.

The very foundation of decay control is careful handling; in fact, there is no substitute for it. To be effective in checking decay, careful handling must be practiced not only by the picker but also by the dumper, the grader, the packer, the lidder, the loader, and even the unloader. Rough handling at any time opens wounds for the entrance of rot fungi, terminating in decay days or weeks later. This subject is fully covered in B. P. I. Bull. No. 123 and Bull. No. 62 issued by the U. S. Department of Agriculture. Their contents are generally known and recognized by the industry; yet the knowledge is not put into general practice sufficiently in the Gulf States to prevent the decay that properly must be attributed to rough handling anywhere along the line.

Let us view the over-all problem realistically. Our economic conditions are such that the modern shipper and fruit handler must move through his packing house an increasingly large volume of fruit per man-hour in order to survive. This calls for faster operation all along the line, which in turn means rougher handling and a larger percentage of bruised and otherwise damaged fruit that is likely to develop green mold rot. If rough handling practices are a necessary part of rapid operations and are with us to stay, then the decay that might be prevented by careful handling at all stages, from the grove to the consumer, must be checked by other means.

Several methods of decay prevention are available; harvesting methods including those that separate the fruit from the infected part of stem buttons, chemical antiseptics to retard the development of the rot-producing fungi, and refrigeration. All are effective, but since practices and equipment vary from packing house to packing house, methods well suited to large operations may not be feasible for smaller units.

Harvesting practices play an important role in the development of decay during the normal marketing period. Carelessly clipped fruit may be injured either by the clippers when the fruit is being severed from the tree or later by stems which are not sheared at or close to the calyx. Clipper cuts on the rind are commonly observed where clippers with long shearing surfaces are used. The liability to this injury is lessened by the use of clippers with short shearing edges. Long stems or stubs are likely to puncture the rind of the fruit as it rolls along over the brushes or other conveyors in the packing house. If the wounds are deep enough to rupture the outer rind and if the fruit is held in a relatively high humidity soon after packing, blue mold is very likely to develop, to even a greater extent during the winter months when this form of decay is most prevalent than at other seasons.

Pulling of citrus fruit—picking without the use of clippers—is now common practise. During the greater part of the season oranges can be pulled with but little resultant rind injury if the workmen exercise reasonable care. However, the period when ripe tangerines can be pulled with reasonable safety is very short. On the other hand, grapefruit, Temple oranges, lemons, and limes can be pulled throughout the shipping season with but slight likelihood of tearing the rind. With fruit that lends itself to this method of harvesting, there appear to be two distinct advantages of pulling over clipping, namely, economy and reduction of decay. If only the portion of the stem with the "collar" or calyx points is removed from the fruit during the pulling operation, the liability to stem-end rot is lessened; when all of the stem button is removed, stem-end rot is further reduced. Ordinarily, pulled fruit is not so liable to stem-end rot as clipped fruit, but it may be more liable to green mold, especially with careless harvesting. Regardless of the method of harvesting, more or less numerous lesions or abrasions may be expected to appear on the fruit before it reaches the packing house. For that reason an antiseptic treatment given to fruit soon after it is harvested regardless of harvesting methods is especially desirable as an effective measure in checking mold rot. However, such an application does not protect against decay developing in subsequent wounds made during the packing, lidding, or loading operation.

Although antiseptic treatments have long been employed for checking decay in citrus fruits, the use of only such materials as involve no hazard to health is permitted. However, the application of these harmless materials is often so modified to fit the convenience of the operator that their effectiveness is greatly reduced.

Carefully checked experiments have shown that these treatments reduce the damage caused by stem-end rot and the mold rots. The warm, humid air maintained in coloring rooms is extremely favorable to the growth and spread of rot-producing fungi, especially Diplodia. Prior to the adoption of the practice of applying effective antiseptics, a large percentage of

decay developed rapidly after the degreening treatment, especially when the coloring rooms were not properly operated. This class can be greatly reduced by proper application of the borax treatment before degreening, or of either of two phenolic compounds afterward.

The logical time to apply mild, slow-acting antiseptics of the soluble type (borax being the cheapest and most generally used form) is as soon as possible after the fruit is harvested, preferably within a few hours. If the application is delayed even overnight, its efficacy against the green and blue mold rots is considerably reduced, and it is not likely to be so effective against stem-end rot. Borax is more effective against Diplodia stem-end rot than against Phomopsis, whereas boric acid is more effective against Phomopsis than against Diplodia. This difference may explain some of the inconsistent results obtained from the use of these materials. Thus in the spring when Phomopsis stem-end is likely to predominate, boric acid may be more effective than borax. For best results the borate should be left on the fruit several hours before it is rinsed. Cost and safety considered, an application of borax made as soon as the fruit reaches the packing house, whether the fruit needs degreening or not, is the most effective approved antiseptic treatment when the marketing period is likely to extend to 2 or 3 weeks or longer.

In warm weather a momentary dip in the Borax solution is as effective as a bath of several minutes, but in cold weather a longer submersion is necessary in order to warm the fruit somewhat to prevent the borax solution from being weakened through chilling and precipitation at the cold surface of the fruit. Since this bath must be kept at temperatures around 100 degrees to 110 degrees F. to maintain the proper concentration of borax in solution, provision must be made to heat the solution.

The relative insolubility of borax is a disadvantage that can be partly overcome by using a mixture of two parts borax to one part boric acid with a little heat to keep the mixture in solution. Such a mixture is considerably more soluble than borax but more likely to injure fruit that barely passes legal maturity.

Several platform machines have been devised for the borax treatment. The fruit is emptied at one end of the loading platform and passed through a vat containing a 5 to 8 percent borax solution heated to about 110 degrees F. A conveyor belt carries the fruit out at the other end of the vat, where it is replaced in field boxes and is then ready for the coloring room, or is set aside for several hours if the fruit does not need degreening.

An important factor in the effectiveness of the treatment, particularly against stem-end rot, is the rate of drying of the borax solution since ordinarily better rot control is obtained when several hours are required to dry the fruit.

A less effective but more convenient and more popular method of application consists of a borax tank, located between the washer and the drier, through which the fruit passes. A light spray of water is played on the fruit after it emerges from the tank to remove adhering borax. This is necessary in order to comply with food laws.

Sodium ortho-phenyl-phenate, a quick-acting, powerful material in use for a number of years, although not as safe or enduring as borax, is effective in checking stem-end rot and the mold rots for about 2 or 3 weeks. It can be applied

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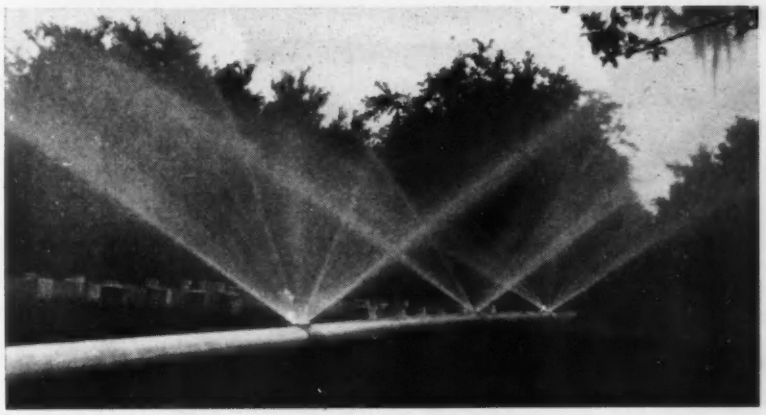

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with little if any extra effort when used with a wax emulsion just before the fruit is packed. It is important that the material be flooded on or the fruit dipped to assure thorough coverage. The excess material is drained to a small tank, then pumped back on the passing fruit. When the disinfectant is thus applied, its concentration should not exceed 1 to 1¼ percent, nor be less than 3/4 percent; the treatment should be given at room temperature. After treating every three of four cars, a one-fourth normal charge of the antiseptic and wax should be added to keep the tank mixture at full strength. Rind injury from this material manifests itself as small, reddish splotches that may not develop until 10 to 15 days after treatment. Ordinarily these splotches are of no commercial significance.

Diphenyl, a promising decay inhibitor, has been in use for several years. Insoluble in water, diphenyl can best be applied in wrapping tissue, box or bag liners, or separator sheets between layers of fruit. All of these carriers have proved effective in commrcial operations. Pulverized diphenyl sprinkled in kraft bags at the time of packaging has proved effective also. Since diphenyl is slowly volatile, the greater the amount used per crate of fruit. within reasonable limits, the longer the effectiveness. Between ¼ and 1/3 ounce per crate is the minimum effective dose when treated wraps are used. As diphenyl volatilizes, a pungent odor is given off, which arrests decay so long as the characteristic diphenyl odor remains. When the odor disappears, the rot-producing fungi resume growth and decay may set in. Except in rare instances no ill effects following use of diphenyl have been noted either on the rind or juice, regardless of strength of application. Because of pungent odor and liability to taint butter and various other foodstuffs, diphenyl is not popular for treating small consumer packages that may find their way into apartments or perhaps into refrigerators where an assortment of foods capable of absorbing the diphenyl odor may be stored.

In summation, borax and diphenyl are at least as effective in suppressing stem-end rot, for a reasonable period, as they are against the mold rots.

There are other materials more effective in checking decay, but because of the hazard to health their use cannot be recommended. A bad feature in conection with the use of antiseptics on fruit is that many workmen are inclined to handle treated fruit less carefully. However, the use of antiseptics as well as refrigeration is especially desirable if the fruit is to be held several days at room temperature after arrival at market. At best, decay reduction is all that can be expected from the use of antiseptics, whereas refrigeration checks decay and also preserves the fresh-from-the-tree flavor and appearance.

Of the various means of retarding or preventing spoilage during the transit period, refrigeration is perhaps the most commonly employed. So long as the commodity is held at temperatures too low for the growth of the rot-producing fungi, decay is retarded, life processes of the fruit are slowed down, and the freshness of the commodity is preserved. However, it is important to remember that low temperatures protect the fruit against deterioration and spoilage only so long as the fruit is kept cold.

Weak or injured fruit shipped under effective refrigeration usually arirves at destination in an apparently sound condition but goes down rapidly with decay within a few days after the commodity is transferred to ordinary temperatures. Fortunately our principal rot-producing fungi are rendered inactive at fairly moderate temperatures. Unfortunately, refrigeration, or rather haphazard attempts at it, too often fail to produce the desired results. A temperature somewhat below 50 degrees F. affords ample protection if the fruit can be precooled to that level soon after packing and can be held there during the normal transit and marketing period. The success or failure of refrigeration during this period depends largely upon the speed with which the fruit is brought to the desired temperature of 50 degrees or somewhat lower. It can be attained within a comparatively few hours in well equipped precooling rooms, but few packing houses have precoolers. The progressive change in commodity temperatures in oranges precooled in rooms and a typical air temperature during that period are shown in figure 1.

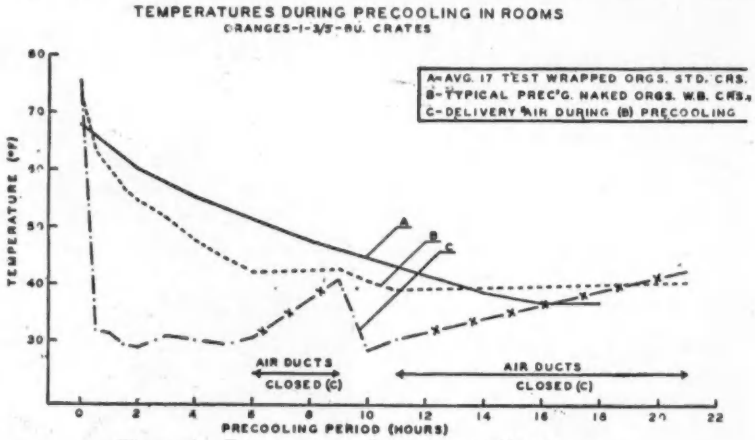

Figure 1. Temperatures during precooling in rooms

(A), the average of results from 17 tests, indicates that approximately 7 hours were required to reduce the commodity temperature of wrapped oranges in standard crates from about 68 degrees to approximately 50 degrees. Some 13 hours were required to reduce the temperature to 40 degrees. (B) is a

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typical log of temperature reduction in a room filled with naked oranges in wire-bound crates. The naked fruit cooled more rapidly than wrapped fruit. Four hours were required to reduce the pulp temperature from 73 degrees to approximately 50 degrees. About eight hours of blowing reduced it to 40 degrees. Thus it is obvious that naked oranges cool much more rapidly than wrapped ones. (C) shows the log of air temperature during the precooling of (B).

During the periods when the air ducts were closed, the "soaking period," commodity temperatures tended to equalize without much if any rise. During the "soaking period," temperatures were taken only at the beginning and end; hence the line connecting these points may not be entirely accurate. It is likely that the temperature of the still air was not long in rising to approximately that of the commodity. The common practice is to operate the fans intermittently during the precooling operation since nothing of practical value is to be gained by continuous blowing. Even with its speed of cooling, the operation is not fast enough to enable the same room to be emptied twice during the ordinary working day if a thorough job of precooling is desired.

Citrus fruit can also be precooled after loading into refrigerator cars. Two methods are in use: (1) A mobile precooling unit mounted on a motor truck, built somewhat on the plan of air-conditioning units. This machine is placed at the door of a loaded car and is connected with the car by means of a specially designed air tunnel fitting snugly into the doorway. A high-powered fan forces air through the cooling coils of the precooler and delivers it over the top of the load. The air pressure forces the cold air down through the load and returns it to the precooler through the bottom part of the doorway of the car. This precooling service is supplied by companies who maintain and operate such equipment. (2) Another method utilizes ice for precooling the load. Ordinarily the ice bunkers of the refrigerator car are filled to capacity with ice before or during loading. If the car is of the ordinary end-bunker or standard type, an electric fan (bunker fan) with specially designed baffle is attached to each upper bunker opening before the car is loaded. After loading is completed, the fans are turned on, drawing air up through the ice-filled bunkers and forcing cold air over the top of the load down through the load to the floor racks beneath, and back to the ice bunkers to be recooled as the air passes up the bunkers again to the fans. After the car has been precooled, the fans and baffles are removed.

Some end-bunker cars are equipped with a built-in fan under the floor rack at each end. These fans (Preco fans) force air up through the iced bunkers, across the top of the load, down through the crates, and back to the fans beneath the floor rack. They are operated by small gasoline or electric motors on the outside of the car attached directly to the fan axles that extend through the car sidewall. When the precooling is completed, the motors can be removed readily. The fans are so constructed that by throwing a hand lever they can be made to operate when the car is in motion by means of a belt drive from the car wheels, thereby forcing a rapid movement of air through the load during

(Continued on page 22)

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SOLVING CITRUS PROBLEMS

The disastrous slump in prices received for Florida citrus fruits this season has given rise to innumerable suggestions and some actual efforts at the creation of organizations to correct prices and solve other citrus problems. These suggestions and these efforts range all the way from purely grower control of the situation to that of united action by growers, shippers and canners.

The ideal situation, of course, would be the absolute grower control of marketing and distribution of their product. But, to be successful, that would require the cooperation of all, or practically all, Florida citrus growers. Judged by past experience, any such organization of growers in Florida is out of the question — there is too much rugged individualism and too much leaning toward free enterprise in the Florida citrus industry to hope for any such united effort among growers.

Next best and most feasible set-up, it would appear, would be some organization embracing all elements of the industry — growers, shippers, canners and allied interests, with sufficient membership and sufficient strength to control grades and regulate shipments. Steps are now being taken for the formation of such an organization — indeed, steps are being taken for the formation of more than one such organization, which may make for confusion where unity is the prime essential.

First of all, however, and this step is recognized by all, greater stress must be placed upon quality. Shipment of unripe or underquality fruit must be eliminated if hope of success for any program is to be entertained. There is where the grower and the shipper must join hands — it is their joint responsibility. It is the foundation upon which any enduring superstructure must be built.

The time is ripe for the organization of a great central control body embracing every phase of the industry, every element, every faction, from grower to packer to shipper to canner. Let us not, like last year, wait for another freeze to boost the price.

FLORIDA NOT ALONE SUFFERS

Florida citrus growers are prone to think that their troubles and their problems are peculiar to the state. Evidently citrus growers in other states do not accept this theory. Take, for instance, the grapefruit growers of Texas, who contend that their problems are greater than those of the Florida citrus grower, as the following excerpts from Texas Farming and Citriculture demonstrate:

"Recent meetings of the Rio Grande Valley's Citrus Advisory Committee have resulted in a shippers' agreement to withhold from the markets grapefruit having no better quality than No. 3 grade. This is obviously a step in the right direction, but it is voluntary and so lacks strength. Almost always in a voluntary agreement of this kind there are individuals who soon kick out. Others follow and the voluntary agreement ceases to exist.

"Even if the agreement pertaining to No. 3 grapefruit survives long enough to improve returns to growers, it is but one step where not a few are required to reach the goal of sound business principles and practices in marketing Texas citrus. Need for the long pull are measures for more fruit distribution in territories outside the big cities, higher levels of quality, more cooperative growers, better regution of shipments in times of market stress.

"For achieving these objectives the citrus industries of California and Florida have more resources as yet than has the industry in the Rio Grande Valley. For one thing they have had a much longer experience in citrus marketing.

"The California industry has had for a considerable number of years a marketing agreement. Whenever the market situation appears to need all-out unity of action an established body of growers and shippers limits weekly shipments to a specified number of cars, prorated among the shippers. This season, as many times before, the agreement has proved its value to California citrus growers. Jointly with them the Arizona growers have a successful marketing agreement.

"The Florida industry, too, has this resource for adjusting shipments to market conditions, but only grades and sizes and not volume are covered, so the operations have been less effective than in the Far West, and have been supplemented recently by shipping holidays.

"Here in the Valley in the late thirties we had a full-fledged marketing agreement with the Secretary of Agriculture, and it made a highly favorable impression on a great many growers. But a certain element apparently dedicated to freedom of enterprise for themselves, regardless of others, attacked it so persistently and noisily that the Secretary annulled the agreement, believing, it has been said, that one wouldn't be used with the desired effectiveness by people who couldn't keep their house in some degree of order.

"The scene has changed since then. A get-together spirit is coming to the front in the relationship between the cooperative growers' shipping representitives and the others. Both groups have members on the Citrus Advisory Committee, which is ironing out differences of attitude toward marketng problems."

Improved Uses of Fruit Production To Be Sought Through Research

New and improved uses of citrus products and the design and construction of a satisfactory press for commercial recovery of juice from pears and other fruits and fruit wastes are the objectives of two research projects recently approved by the U. S. Department of Agriculture to be carried on under the Research and Marketing Act. Both projects have been assigned to the Bureau of Agricultural and Industrial Chemistry.

In approving the project for developing new and wider uses for citrus fruit, E. A. Meyer, administrator of the Research and Marketing Act, pointed out that the rapidly increasing production of citrus intensifies the need for finding new outlets. Plans are to attack the problem from several angles which will include the following: Develop commercial-scale methods for the manufacture of citrus powders that are of high quality, wider usefulness, and of better keeping quality; isolate and identify the volatile flavoring elements of fresh orange juice and study the chemical changes that occur in these elements as a result of processing in the hope that this information will assist in developing improved methods of processing; make chemical studies of citrus juice pasteurization; determine the significance of enzymes in causing citrus products to deteriorate after they have been pasteurized; and develop a better way of testing citrus fruit for maturity.

With regard to the project to recover juice from pear and other fruit wastes, research has already demonstrated the value of pear juice from cannery waste as a medium for growing feed and possibly food yeast. The problem now is to develop a satisfactory continuous type press to do the job and this is the objective of the current project. If this can be done it will not only solve a serious waste disposal problem, but will put to practical use the some 50,000 tons of waste that occurs annually at pear processing plants. The requirements for a satisfactory press will be prepared by researchers of the Western Regional Research Laboratory at Albany, Calif., but plans are to have the model for such a press designed and constructed under private contract in accordance with contracting authority of the Research and Marketing Act.

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Spreading Decline Of Citrus In Florida...

R. F. Suit

Citrus Experiment Station, Lake Alfred at meeting Florida State Hurticultural Society

Introduction

Within the past 10 to 15 years a diseased or declining condition has appeared in various groves. This condition is being called "spreading decline" because of the manner in which the trouble gradually spreads through a grove from a focal point of one or two trees that first showed the disease.

It has been reported (7) that there are 10 major causes for tree decline in Florida. Of these 10 causes, spreading decline is third in importance, being surpassed in prevalence by foot rot and root rot. Since this type of decline is a comparatively recent development and is becoming more prevalent each year, it is a serious threat to the groves of Florida. While most of the other causes of decline usually attack scattered trees in a grove, the spreading decline has a potential possibility of causing a whole grove to go out of production over a period of several years.

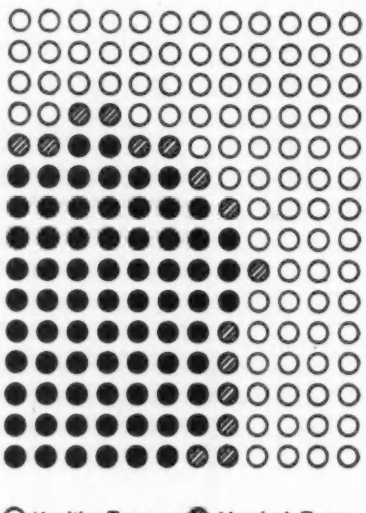
Investigations were started in 1945 to determine the nature and cause of this type of decline and to develop measures for its control. Although the work has not been completed, sufficient results have been obtained to indicate the nature and probable cause of the spreading decline.

Symtoms

A spreading decline area in a grove shows certain characteristics. All of the trees in the declining area show the symtoms while there is a sharp contrast at the border of the area or margin with declining trees on one side and healthy appearing trees next to them on the other side. A map of a typical spreading decline area is shown in Fig. 1. A diseased tree gradually becomes weakened by loss of foliage coupled with a lack of new growth. Such trees bear no fruit of commercial value and show sparse foliage and many dead twigs and branches. Data show that the first visible symptoms of spreading decline appear in a healthy tree adjacent to the margin of the decline area at the time of the spring flush of growth. These symptoms are: a variation in the amount of new growth in which some trees produce no new growth at this time and others only a scattering; in others the flush is delayed 2 or 3 weeks; and in all cases there is a loss of a large percentage of the older leaves causing the tree to have sparse foliage.

This decline of the tree is the effect of the condition of the roots.

Figure 1.



Map of a portion of grove No. 1 showing the typical localized distribution pattern for spreading decline.

The root system shows a scarcity of fibrous or feeder rootlets and a certain proportion of the fibrous rootlets that are present have an abnormal appearnce. These rootlets are distorted, stunted, thickened and have soil particles adhering to them that can not easily be shaken off. When such rootlets are examined the cortex readily comes off leaving the white woody cylinder of xylem tissue.

Trees which show spreading decline never die but usually maintain a weak type of growth. As long as there is sufficient moisture in the soil the foliage appears to be in good condition except that it is sparse. When adverse moisture conditions prevail, the spreading decline trees show a wilting condition while the healthy appearing trees adjacent to them show no wilting until the lack of moisture becomes critical.

Another characteristic of this type of decline is the gradual spread of the condition in the grove. A total of 10 blocks of trees have been mapped for decline occurrence during the past two years. The rate of spread of the decline in these blocks for 1945-46 and 1946-47 is shown in Table 1. The data show that the rate of spread for 1946-47 was 64.5 percent greater than in 1945-46. One possible explanation for this difference is the fact that the spring of 1945 was exceptionally dry while the spring of 1946 was more nearly normal in the amount of rainfall. There was considerable variation in the rate of spread found in the various groves. Those groves which had received proper nutritional, spray and irrigation programs showed, in general, the lowest rate of spread. This condition will spread in any direction regardless of the elevation of the land.

Occurrence

Spreading decline has been found, on Hamlin, Parson Brown, Pineapple, Valencia and Temple varieties of orange trees, on Marsh and Duncan grapefruit trees and tangerine trees. Grapefruit trees show a greater effect from the spreading decline than orange or tangerine trees since they have a higher water requirement than the other two kinds of citrus. The condition has been found on trees with rough lemon, grapefruit and sour orange rootstock. To date, spreading decline has been found in 54 blocks of citrus trees. The trees have ranged in age from 9 to 50 years. There were 24 blocks of grapefruit, 27 blocks of orange and 3 blocks of tangerines in which

(Continued on page 14)

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SPREADING DECLINE OF CITRUS IN FLORIDA

(Continued from page 12)

the condition was found. The location of the blocks in which the decline occurred was as follows: 44 in Polk County, 3 in Hillsborough County, 2 in Orange County and 1 each in De Soto, Highlands, Lake, Pasco and Pinellas Counties. A systematic survey of all citrus groves throughout the citrus areas in the state has not been made to determine the actual situation, but the data at hand gives a relative indication of the prevalence of spreading decline.

Table 1.—Rate of Increase of Spreading Decline in Groves Under Observation.

Grove No.	Increase in number of diseased trees per tree on margin of declining area	
	May 1945 to April 1946	April 1946 to May 1947
1	0.56	1.12
2	1.00	0.82
3	0.21	1.65
4	1.58	1.10
5	0.27	0.77
6	0.47	1.06
7	0.61	0.64
8	1.00	2.00
9	1.22	1.38
10	0.66	1.50
Average	0.79	1.20

Cause

The peculiar condition of the rootlets found on the trees showing spreading decline might be caused by a fungus disease, a virus disease or by nematode infestation. In the experiments to determine whether the trouble was a fungus disease, several fungi (**Fusarium** spp., **Diplodia** spp., **Cephalosporium** spp. and a few unknown species) were isolated for the affected rootlets but none of them proved to be pathogenic. Also, there was no significant differences in the microflora of the soil in the declining area compared to that of the soil in the declining area compared to that of the soil in the healthy area in four groves where an intensive study was made. Numerous experiments were conducted in which budding, grafting and leaf grafting tests were made to determine if a virus could be transmitted. So far there has been no evidence obtained which would indicate that the spreading decline is a virus disease.

Although it had been considered that a nematode might be associated with spreading decline, it was not until in November, 1946, that they were actually found. Since that time, examination of the abnormal rootlets from the 54 blocks under observation has shown that a nematode was associated with the condition in all cases. In 16 of the blocks typical female nematodes were found that identified the nematode as **Tylenchulus semipenetrans** Cobb, the citrus nematode.

A survey of the available literature on the citrus nematode (1, 2, 3, 4, 5, 6, 8, 9, 10) gives the following information concerning this pest. The only known host of **Tylenchulus semipenetrans** is citrus and this nematode was first discovered in California in 1912. It was first found in Florida in 1913 and between 1914 and 1917 was found at Glen St. Mary, Gainesville and Brooksville. Today the nematode has been found in most of the citrus producing areas throughout the world. In Argentina, Mr. E. P. Du Charme who is on leave from the Citrus Experiment Station and who is working on the Tristeza Project at the Experiment Station, Concordia, reported that the citrus nematode was present in most groves and that the **Poncirus trifoliata** rootstock showed some resistance to nematode infestation (unpublished data.)

The male and larval stages of the nematode are worm-like and less than one-half millimeter long. These forms are usually free-living in the soil adjacent to the rootlets although they may feed on the outer layer of cells of the rootlet. The female penetrates the cortex of the rootlet with the anterior portion while the posterior part swells up and remains outside of the rootlet. Once the female penetrates the root it becomes fixed in that position for its life. The eggs are laid in the soil adjacent to the rootlet and hatch within two or three days. It requires about 6 to 8 weeks for a complete life cycle. The feeding of the nematode in the cortex results in a disintegration of the cambium region which causes the rootlets to become distorted, stunted and thickened. The infested rootlets eventually die. It is reported that the appearance of the tree is an indication of the amount of infestation of the roots. Thus, the decline is caused by a scarcity of healthy fibrous roots. The citrus nematode has been found to exist in the soil for as long as three years without citrus being present and has been found in the soil to a depth of 6 feet in California. The nematode is usually introduced into a grove by planting infested trees and also may be spread by cultivation operations as well as irrigation water and rain. In California the effect of the citrus nematode on citrus is known as "slow decline."

Table 2.—Occurrence of the Citrus Nematode in Groves Examined.

County	Number of Groves			
	With Spreading Decline		Healthy	
	Nematodes Absent	Nematodes Present	Nematodes Absent	Nematodes Present
Polk	0	44	26	11
Highlands	0	1	11	2
Lake	0	1	9	0
Orange	0	2	1	1
Hillsborough	0	3		
Sarasota	0	0	4	0
Osceola	0	0	1	0
Pasco	0	1		
DeSoto	0	1		
Pinellas	0	1		
Manatee	0	0	0	6
Indian River	0	0	6	3
Total	0	54*	56	23**

* Positive identification of **T. semipenetrans** in 16 of the groves.
** Positive identification of **T. semipenetrans** in 9 of the groves.

A random survey of some groves in Florida indicates that the citrus nematode is quite widely distributed. As shown in Table 2, the nematode has been found in 10 of the 12 counties where samples have

been obtained. Nematodes were found in all areas of spreading decline observed and **T. semipenetrans** females were present in 30 percent of the areas. In the other location the nematodes found appeared to be male or larval stages of the citrus nematode. The healthy appearing trees around the spreading decline area also had nematode infestation. The nematodes have been found on healthy appearing trees in the same block as far as 500 feet from the area showing the decline but a study of the relationship has not been completed. It is possible that further tests will show the nematodes to be present throughout a grove which has a spreading decline area in one corner. It is also shown in Table 2 that nematodes have been found in 23 groves that do not have spreading decline. Of these 23 groves there were 9 in which **T. semipenetrans** females were found while in the other 14 groves the nematode count was very low. It is possible that, where nematodes are found in healthy groves, the infestation has not developed sufficiently to cause the spreading decline. There appears to be no definite time limit on the occurrence of spreading decline. As previously mentioned the condition has been found in groves from 9 to 50 years of age. In one grove it is known that the trees have been infested with nematde for at least 11 years but show no decline symptoms in the above ground parts. Thomas (9) obtained decline symptoms in young trees that had been growing in pots of infested soil for 4 years. In another case (4) field tests with young trees grown for 4 years in old citrus soil showed no decline symptoms but had grown only half as much as similiar trees planted in virgin soil. This lack of growth has also been observed in young trees planted in an area where spreading decline trees had been removed here in Florida.

There are a number of facts which indicate that **T. semipenetrans** is probably associated with the spreading decline, although it may be that there are some other factors which have an effect.

1. The nematodes have been found in all areas that show spreading decline.

2. In the soil extraction tests about 80 percent of the nematodes are the citrus nematode, which is approximately the same relation as found with the nematodes from the slow decline in California (4).

3. The abnormal appearance of the infested rootlets is identical with the illustrations and descriptions of citrus-nematode rootlet injury given in the literature.

4. A **Fursarium** spp. was isolated most frequently from the abnormal rootlets and this fungus has also been reported as associated with slow decline in California (3, 4, 9).

5. Trees which show the spreading decline never die unless foot rot or some other disease is present. If the condition was caused by a fungus or virus disease, it is proable that the tree would die. It appears that the tree is able to maintain a few healthy roots even though a large proportion of them may be infested with the nematode.

One characteristic of this type of decline which has not been reported in connection with citrus nematode infestaion in other regions where citrus is grown is the gradual spread of the condition in a grove. Generally the decline is first observed in 1 or 2 trees and then gradually spreads in all directions from this focal point affecting every tree as

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it goes. Thus, it would appear that the casual agent or agents is primarily spread by root contact from one tree to another. Because of this peculiar behavior of the decline it is possible that there are factors in addition to the citrus nematode that have an effect.

Control Experiments

Before the probable cause of the spreading decline was determined, experiments on control of the condition was of three types; severe pruning, tree injection and soil treatment in an effort to induce renewed growth. Approximately 500 trees have been treated in various ways. Some trees were cut back to 3/4-inch wood which removed all of the foliage, while other trees were buckhorned. During the season following pruning, the treated trees made excellent growth but during the second season the growth was retarded and the trees again started to show the typical spreading decline appearance. In some experiments solutions of different concentrations of 8-hydroxyquinoline sulfate, sulfanilamide and other similar materials were injected into the declining trees through the roots. No beneficial effect was obtained. Treatments have been made to the soil around declining trees to try to induce recovery and to the soil around healthy appearing trees adjacent to the decline area in an attempt to keep them from becoming diseased. Copper sulfate at 5 to 20 pounds, sulfar at 50 to 100 pounds, ammonium sulfate at 20 to 60 pounds, sodium chloride at 10 to 40 pounds, aluminum sulfate at 15 pounds. hydrated lime at 50 pounds and Dithane at 3 pounds per tree have been tried at various times and in different groves. None of the treatments caused any beneficial effects to the declining trees.

Typical results from the treatments on the healthy trees adjacent to the spreading decline area are shown in Table 3 which is the data obtained from one experiment. None of the treatments prevented the healthy trees adjacent to the decline area from becoming diseased within one to two years. Thomas (9) tried a total of 16 materials as soil treatments and obtained no control of the citrus nematode.

After it was established that the citrus nematode was associated with spreading decline, experiments were conducted to determine the effect of certain soil fumigants on the citrus nematode and on the trees. Injections of D-D (equal parts of 1,3-dichloropropene and 1,2-dichloropropane) into the soil were made to a depth of 6 inches at rates of 2, 3, 4 and 5 ccs per square foot of surface area. Examination of the rootlets from the treated trees showed that all of the dosages had given control of the citrus nematode at least in the top two feet of soil. Since the nematode is known to exist to depths of 6 to 8 feet under California conditions and to a depth of at least 3 feet in Florida, the higher dosages of D-D per square foot would result in more effective control. However, dosages of 2, 3, 4 and 5 ccs per square foot resulted in the death of the trees when the whole root area (625 square feet) was treated either in February or April. The trees treated in April died more rapidly than those treated in February. If only half of the root area (312 square feet) of the tree was treated, excessive injury was caused by the 3, 4 and 5 ccs per square foot dosage while those treated with 2 ccs per square foot showed a shock from the treatment and were in poor condition on October 15, 1947, but may recover. It is doubtful if D-D can be used to treat the soil in which trees are growing.

Additional tests were made with Dowfume W-10 (10% Ethylene dibromide) and two Dow materials labelled S-991 and S-684. These materials used at 2 and 4 ccs per square foot were not as effective as the D-D for the control of the citrus nematode. However, at the 2 ccs per square foot dosage there was apparently no serious injury to the trees.

It would be possible to control the citrus nematode by removing the declining trees and treatinig the soil with a fumigant. The area could then be replanted with young nematode-free trees. This has been reported (4) as the only treatment found to be beneficial wherever properly tried.

At the present time it appears that the citrus nematode is probably one of the factors responsible for the spreading decline in Florida. However, the spreading characteristic of the decline has not been reported from other areas where the citrus nematode occurs. Thus, it would appear that there may be other factors which have not been discovered at this time and which may be responsible for the spreading condition. Further investigations will give some information on this point and will also determine whether a material can be found that will control the citrus nematode without serious injury to the tree. It is also possible that a rootstock may be found that is resistant or immune to infestation.

Table 3.—Effect of Soil Treatment on the Control of Spreading Decline.

Material	Pounds Per tree	No. trees Treated*	No. diseased trees on 4-19-46	11-21-46	5-26-47
Copper Sulfate	10	34	9	10	31
Sulfur	50	35	1	6	31
Ammonium Sulfate	20	36	4	6	32
Non-treated	—	35	5	8	32

* Treatments were applied in December, 1945.

Summary

Spreading decline has been increasing during the past 10 to 15 years and is now third in importance as a cause of decline in a grove. It occurs on grapefruit, oranges and tangerines budded on rough lemon, grapefruit or sour orange rootstock.

To date the condition has been found in 54 blocks of citrus ranging from 9 to 50 years of age. It has been found in 8 counties, but is most prevalent in Polk County.

The spreading decline is apparently not caused by a fungus or a virus disease but appears to be the result of the infestation of the rootlets by **Tylenchulus semipenetrans** (Cobb.) The citrus nematode was also found in 9 of the 81 healthy groves examined and was found in 10 of the 12 counties where groves have been examined.

The average rate of spread of the decline in 1945-46 was 0.79 trees per tree on the margin of the declining area and in 1946-47 was

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1.20 trees in the 10 groves which were under observation.

No control of the spreading decline was obtained by various types of pruning, tree injection with various chemicals in solution or by soil treatments with copper sulfate, sulfur, ammonium sulfate, sodium chloride, aluminum sulfate, hydrated lime or Dithane. The citrus nematode was controlled by dosages of D-D at the rate of 2, 3, 4, and 5 ccs per square foot of area, but in practically all cases the trees were killed by this treatment, except when only half of the root area was treated with the 2 ccs per square foot, in which case the trees lost considerable foliage but were not killed.

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A 4-H club for boys was organized recently in Lake City, with 47 members, according to County Agent John M. Kennedy. Seven boys have secured breeding pigs as their projects and others have broilers. Still others will grow sweet potatoes. Nearly all of the boys will raise a home garden, Mr. Kennedy reports.

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McCoy Suggests Marketing Plan...

The proposal of G. H. McCoy, former manager of Swift & Company's phosphate mining operations in the vicinity of Bartow, now retired, that Florida's citrus marketing problems might be solved by means of the same practice put into effect by the country's large meat packers has been greeted with serious attention by certain groups of citrus growers in the Bartow area.

The unquestioned necessity for doing something to relieve the confusion which now exists and the marketing inequities which prevail under the present auction market method, have brought forth several proposals from varied citrus factors in the state who are vitally interested in seeking a solution which would result in a stabilized marketing program.

McCoy's plan, like most others, is predicated upon the assumption that the cooperation of growers and shippers can be attained to a sufficient degree to warrant control of the major portion of Florida's citrus in order that the plan may be made effective.

He recalled how in years past the meat packers had found it impossible to market their products at a profit, and finally solved their problems by establishing branch houses in all territories where there was any substantial market for their merchandise.

McCoy states that "today there are three major objections to the present set up."

"First," he states, "there is too much poor fruit being shipped into the markets.

"Second, there are too many intermediate handlers between the producer and the ultimate consumer.

"Third, inadequate distribution of the crop."

The number one objection mentioned above can and should be corrected by the packers. The number two and number three objections must be corrected by a complete change in marketing practices.

McCoy states it is his opinion that the example set by the meat packers provides, a workable and effective answer to the present citrus marketing problems. He cites the fact that the large meat packers all have branch houses over the entire nation through which they distribute their meats directly to the retailer, enabling the consumer to secure his meat with only one profit, that of the retailer, between himself and the packer. Florida alone, McCoy states, has in the neighborhood of fifty such branch houses.

He states that in his opinion the citrus industry of Florida could follow the same pattern of distribution by establishing warehouses at strategic points and distribute their citrus crop through these mediums to the retailers, eliminating broker's and wholesaler's services.

The supply in each district, according to McCoy's plan, would be restricted to the actual demand of each area, thus eliminating glutted markets, and by routing fruit directly to these distribution points fruit would reach the consumers in a fresher, better condition than at present.

McCoy says that under this program distribution and sales could be immensely increased through salesmen covering regular routes who contact many small towns and outlying stores, furnishing them with fresh fruit at frequent intervals.

"This plan of distribution," says McCoy, "would also make it possible to show the trade with a little intelligent effort that fresh, uncolored fruit is superior to the colored fruit and result in a considerable saving in packing costs."

McCoy suggests that his plan could be worked out without too much difficulty and could be tried out on an experimental basis without too heavy an investment by trying it out in one district or in one state as a proving ground.

Schools Use Health Information

Many hundreds of schools and city health departments throughout the country make use of nutrition and health information supplied by the Florida Citrus Commission, but most of them never get around to sending a thank you note.

Chelsea, Mass., is an execption.

Saying that he was expressing "the appreciation of the citizens of Chelsea for the services you rendered in the name of the Florida Citrus Commission," Mayor Bernard L. Sullivan wrote to the Citrus Commission's sales service representative in the Boston division to thank him for information on the school lunch program and for a supply of medical advertising reprints.

"These reprints," Mayor Sullivan wrote, "contain an accurate flow of information for the school nutritionists, home economics teachers, public health workers and nurses."

The Commission, through its sales service and publicity program, provides nutrition and health educational materials for free distribution to teachers, nurses, dieticians and others.

I've got the right numbers!

The telephone directory is always your best guide to the right number. When you're not sure of a telephone number . . . check the directory before placing your call. This way, you avoid wrong numbers and unnecessary calls to Information.

PENINSULAR TELEPHONE CO.

Graduate Work In Horticulture At The University Of Florida...

H. S WOLFE
Department of Horticulture, University of Florida, Gainesville at meeting of the Florida State Horticultural Society

Horticulture has been for many decades the most important industry of Florida, but this fact has only slowly made its impress upon the educational system of the state. It was not until 1912 that there was a distinct and separate department of Horticulture in the College of Agriculture of the University, it having been treated previously as a phase of botany. Through the years since that time this department has devoted itself to training men for more effective participation in the production of citrus and other fruits, of vegetable crops and of ornamental plants. More course work in citrus culture is offered at the University of Florida College of Agriculture than in any other agriculture college in the United States. We take a justifiable pride in the sound training we have given our graduates and in the prominent places they hold in the horticultural industry of our state.

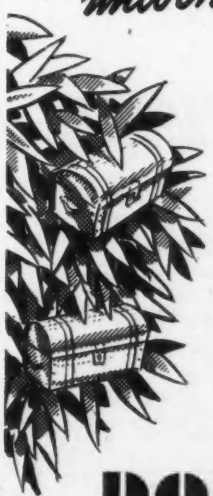
Graduate work in horticulture actually antedates the establishment of a separate department, since the first candidate for a Master of Science with a concentration in horticulture was so registered in 1905. The first M. S. degree for work in this field was given in 1909 to H. S. Fawcett, a man who later became the outstanding leader in the study of citrus diseases. Since his graduation, thirty-two men have received the M. S. degree for horticultural study and research, and have gone largely into teaching and research work in this state and in many foreign countries. In this graduate training the staff of the teaching department have enjoyed the warm and close cooperation of the horticulturists on the staff of the Agricultural Experiment Station. and the research workers and facilities of the Station have greatly broadened the type and scope of the research problems available for pursuit by candidates for the Master's degree.

With the expansion of the research work carried on at the branch stations, there has been an increase of staff until now some of these branches have a larger staff of skilled research men than the Main Station had 20 years ago. We are particularly interested today in the situation at the Citrus Experiment Station, with the tremendous expansion of which in the last few years you are familiar in some degree. The Board of Control has recently, with the full approval of Director Mowry and Vice-director Camp, made it possible to utilize the facilities of the Citrus Station and its staff for instructional purposes. It is now possible to have students work out the thesis research for the M. S. degree at the Citrus Station, where facilities for research in many phases of citrus are much superior to those available at Gainesville. Furthermore, a plan is being worked out which will permit graduates of the College of Agriculture with a horticulture major and special emphasis in citrus culture to interne, as it were, for a semester or a year at the Citrus Station. This period of practical experience in the best modern grove, packinghouse or processing procedures should be a valuable adjunct to the sound training in basic principles and the limited practice in operations which are considered sound educational procedure.

The way is now open for a further step in horticultural graduate training. It is a great pleasure to announce that by reason of this

d/p DOLOMITE unlocks a soil treasure chest

In a year when you need quality at minimum cost



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d/p DOLOMITE is your key to this treasure chest. It renews the magnesium and calcium reserves your trees need for extra, stronger growth and quality yield . . . and it restores proper acid-alkali balance, making acid-locked plant foods available again.

For greater yields and profits in a year when quality and cost are both important factors, start now with annual applications of this great soil tonic.

DOLOMITE Products, Inc.
OCALA, FLORIDA

same effective cooperation, the Ph. D. degree may be now obtained in horticulture at the University of Florida. The research program of our Agricultural Experiment Stations has been greatly expanded in recent years, both in the field of citrus and in that of vegetables. There are at least 6 or 7 men working in each of these broad fields who are fully qualified to direct the research work of candidates for the doctorate. Many other universities in this country give the Ph. D. degree in horticulture with a concentration in vegetable crops, but only our great rival state in citrus production offers a Ph. D. to horticulture students specializing in the citrus field. California has trained many research men for her own service and for other subtropical countries, and Florida will now be able to do the same. Already we have a young man from India who plans to work for a Ph. D. in horticulture, specializing in citrus production.

Facilities and staff at our Citrus Experiment Station are so well developed that a candidate for the doctorate may carry on research in any one of three separate areas: citrus production, citrus fruit handling, or citrus processing. The extensive experimental groves of the Station, as well as the thousands of acres of commercial plantings within a few miles of the Station and available for coooperative research use, together with the splendid library and laboratory facilities of the Station, afford ample scope for research in citrus production. The new research packing-house at the Citrus Station, together with the same library and laboratory facilities, assures proper opportunity for students to carry on advanced research in the handling of citrus fruit to best advantage. And the excellent new building for research in processing problems of citrus fruits, together with the big commercial processing plants located in Polk and adjacent counties, offer unrivalled facilities of thesis research in this important citrus field.

On the vegetable crop side, there is a new processing laboratory nearly completed at the Main Station at Gainesville, and both there and at Bradenton are fields and laboratories for research in production of vegetables. Mention may also be made of the fact that this year for the first time it is possible to offer undergraduate courses in the processing of fruits and vegetables, so that there can be a sound basis for work on the graduate level.

The various physical facilities which I have mentioned as suitable for use in research by candidates for a Ph. D. would be of small value without properly trained and experienced research men to direct the work. We can take pride in the calibre of the research workers on our Station staffs. And the fact that they are busy with investigation of problems important in the citrus and vegetable industries makes it possible for doctoral candidates to select genuinely practical problems for their thesis research too.

I have stressed mainly the research facilities of the Agricultural Experiment Stations, because these are exactly the facilities which the Department of Horticulture of the College of Agriculture does not have in amount sufficient to permit work on the doctoral level. But we have the teaching resources of all the other agricultural departments of the College to supplement our own in the necessary courses to prepare a man for advanced research in horticulture, and this combined with the research men and facilities of the Stations makes possible this latest advance in the training of men for horticultural service in Florida.

A foot-candle, the unit for measuring light, is the amount of light produced by the flame of a standard candle on a surface a foot distant.

MOISTURE PROTECTION

● Your fertilizer is protected from dampness and caking when it's shipped in Multiwall Bags. It's protected, too, against rain when the bags are spotted around the field. Furthermore Multiwall Bags are easy to carry, easy to open—and they ALWAYS empty clean.

And because Multiwall Bags are tough, they do not tear readily. There's no sifting either. So, to get all the fertilizer you pay for, specify Multiwall Bags for your next fertilizer shipment.

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Florida Representative: W. M. Palmer, Ocala, Phone 261, T. F. Sheridan, Jacksonville, Phone 7-7173

Special Treatment For Canning Juice

The "thin" juice from early season oranges can be greatly improved for canning by removing some of the water through partial concentration, an experiment conducted by the Florida Citrus Commission's research department has demonstrated.

More than 97 per cent of tasters who sampled the partially concentrated juice found it better than juice from the same fruit canned without the special treatment.

The Commission research men used two methods to provide a juice with higher solids. In one instance they concentrated the entire batch to the desired level, of from 10 to 12.5 percent solids. In another phase of the experiment they made a 55 degree Brix concentrate which they mixed with the original single strength juice to give it more body.

Both methods gave an end product which the great majority of tasters found to be better than the original single strength juice. Research men said that perhaps the more practical process was the one in which a portion of the juice was highly concentrated and then added back to the original batch.

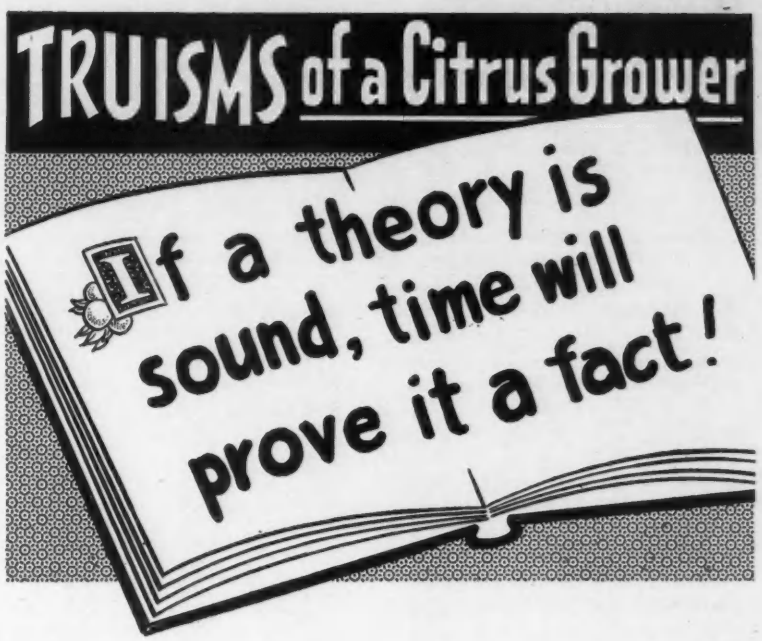
Oranges used in the experiment were of the lowest quality likely to be used for commercial canning. Research men said the tests indicated that plants with concentrating equipment can do much to improve and standardize their juice pack from early season fruit.

No part of the living room baseboard should be more than 6 feet from a convenient outlet, since most appliance and lamp cords are 6 feet long.

American families will continue to pay high prices for food next year, economists of the U. S. Department of Agriculture believe.

REA wiring specialists advise posting a diagram of your wring circuits by your fuse box to help spot the trouble when a fuse blows.

Rats and mice destroy $200,000,000 worth of grain annually in the United States.



• Results of research and the time-tried experience of successful growers emphasize again and again that it takes GOOD fertilizer to produce GOOD fruit. For healthy, productive trees use GULF Friendly Fertilizers—the COMPLETE plant foods that are Florida-made for Florida soils and crops. Let the Gulf Field Man in your section show you how and why GULF Brands save you money in the long run.

Sherwin-Williams Agricultural Chemical Products

Pest and disease control is vital to better fruit. Your local GULF Field Representative now can supply you with the complete line of nationally tested Sherwin-Williams crop protecting products.

GULF Friendly FERTILIZERS

RIGHT for YOUR Soils

RIGHT for YOUR Crops

The Gulf Fertilizer Company • Tampa & Port Everglades, Fla.

DECAY OF FLORIDA CITRUS FRUITS AND ITS CONTROL

(Continued from page 9)

transit. Thus the top of the load is cooled much more rapidly than is possible in conventional end-bunker cars. The fans can be disengaged by the movement of the hand lever, and then the fan car becomes in effect a standard end-bunker. car. When not in operation the fans do not interfere with normal movement of air in the car. The merits of this fan car have been well establishehd. A large and inicreasing number of such cars are in operation in the movement of produce from the Pacific Coast. They are also well adapted to the needs of the shippers of Florida citrus fruits. It is to be hoped that the car lines serving this region will build an adequate number of cars equipped with such fans because with them the top of the load, where refrigeration is needed most, can be cooled quickly at the loading station and kept cool during the transit period as well. Table 1 shows the rate of precooling of naked oranges in wire-bound crates by each of the common practices, viz. fans under the floor rack (Preco), the bunker fans, and the mobile self-contained precoling unit. A total of 22 cars were precooled after loading. At the start of precooling the commodity temperature ranged from 63 degrees to 92 degrees with an average of 76.7 degrees. The precooling period ranged from 5 to 9 hours with an average of 6.8 hours. The total temperature reduction ranged from 5.5 degrees to 26.3 degrees with an average of 16.9 degrees or an average temperature reduction of 2.5 degrees per hour. There was no great difference in the efficiency of the three methods of precooling in cars, viz., the mobile precooler, the bunker fans, and fans under the floor racks.

With heavier loads than those used in these tests the temperature reduction is lessened proportionately because of the greater amount of heat to be removed. The important thing is that precooling requires time, at least 12 hours under the best conditions. When the precooling equipment is operated only six hours. the commodity temperature is not likely to have been reduced more than 15 degrees or 20 degrees. If precooling is done with ice, the bunkers should be replenished before half the ice has melted whenever possible; otherwise the rate of precooling is progressively reduced when the bunkers are less than half full. Under some circumstances the fruit is treated with an antiseptic before it is precooled. This is good insurance, especially when the fruit for one reason or another cannot be cooled quickly to the desired temperaure, or is to be held at ordinary temperatures after unloading at market. Any temperature reduction, however small, does some good. Temperatures above 65 degrees are dangerous; those below 50 degrees are safe.

The capital outlay necessary for precooling rooms is quite heavy, but that needed for equipment to

Table 1.—Average temperature reduction by various methods of precooling oranges in car. 420—1-3/5 bu. wire-bound crates.

Equipment	Commodity Temperature Start	Hours Precooled	Total Reduction	Avr. Hourly Reduction
Preco Fan and ice	71.8 °F	6 °F	13.7 °F	2.3 °F
Preco Fan and ice	76.0	8.25	21.7	2.6
Preco Fan and ice	89.7	8.50	23.0	2.0
Bunker Fan and ice	66.0	6.58	14.9	2.3
Bunker Fan and ice	91.6	7.50	26.3	3.5
Bunker Fan and ice	86.4	6.70	20.8	3.1
Bunker Fan and ice	63.3	7	5.5	0.8
Bunker Fan and ice	67.5	7	11.7	1.7
Bunker Fan and ice	75.4	5	9.7	1.9
Bunker Fan and ice	76.6	5	10.6	2.1
Bunker Fan and ice	69.7	7	10.6	1.5
Bunker Fan and ice	75.4	7	17.3	2.5
Produce conditioner	76.4	5.50	13.6	2.5
do	76.5	6.25	12.6	2.0
do	76.5	5.75	17.5	3.0
do	81.7	9	23.0	2.6
do	84.7	9	23.8	2.6
do	79.2	9	23.3	2.6
Bunker fans and ice	76.1	5.50	23.0	4.2
Produce conditioner	76.4	5.50	13.6	2.5
Bunker fans and ice	75.6	6	19.3	3.2
Produce conditioner	74.7	6	15.9	2.6

ISOTOX
WETTABLE
(PURE GAMMA ISOMER OF BENZENE HEXACHLORIDE)
This ORTHO insecticidal powder mixes ready in water for spray application, or blends with suitable carrier for dusting.
THESE ARE THE PESTS IT CONTROLS . . . cucumber beetles and thrips, aphids and leaf miners, tarnished plant bugs and certain lepidopterous larvae, wire worms and Japanese beetle grubs.
VAPOPHOS
Wettable
The versatile new ORTHO contact poison with residual toxicity, kills red spider mites and hatching mite eggs, most aphids and hatching aphid eggs, mealybugs and scale insects.
ORTHO
CALIFORNIA SPRAY-CHEMICAL CORPORATION
ORLANDO, FLORIDA

precool citrus fruit after loading in cars is not great; however, many packers depend entirely upon refrigeration during transit, as supplied by the carrier. This carrier supplied protective service has proved its value, particularly on long hauls, or on short hauls where a considerable delay in unloading is encountered. Although refrigeration during the transit period only is much better than no refrigeration, it is more desirable to precool the fruit in room or in car followed by appropriate refrigeration in transit as is shown in figure 2. The temperatures recorded are typical of the top of loads—the danger zone—in standard end-bunker cars. In the non-precooled load (A) under standard refrigeration the commodity temperature dropped gradually from about 78 degrees at loading time to 60 degrees at noon of the fourth day. It never reached 50 degrees. Obviously the top of this load was not adequately protected during the greater part of the tarnsit period.

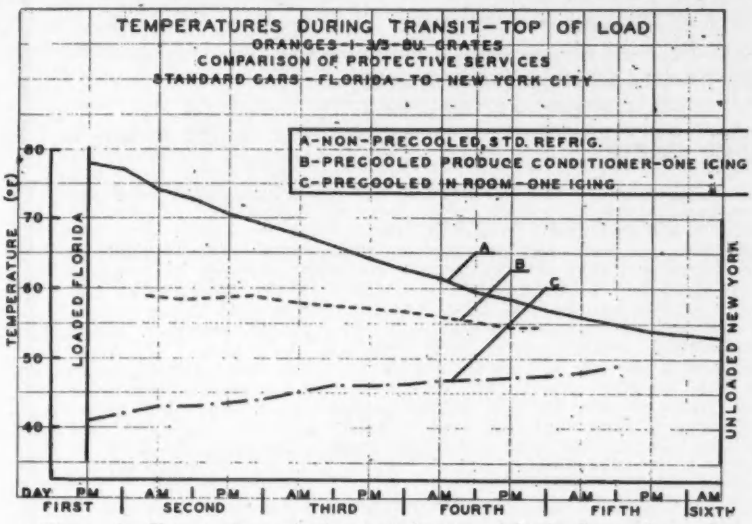


Figure 2. Temperatures during transit—top of load. Comparison of protective services.

Load (B) was precooled in the car with a produce conditioner, the ice bunkers were filled to capacity at the first icing station en route and not replenished later. The commodity temperature was 59 degrees at the end of the precooling period, and it dropped less than 5 degrees during the transit period. This load was fairly well protected throughout the trip to market. Load (C) was precooled in a room to a temperature somewhat below 40 degrees and loaded into a car with bunkers filled with ice. This car was not reiced during the transit period; yet the commodity temperature at noon of the fifth day was still below 50 degrees This load received adequate protection throughout the transit period. These typical loads show a spread of almost 40 degrees in commodity temperature between the three cars at loading time; yet at unloading the spread was hardly more than 5 degrees. If temperatures at unloading were a safe criterion for judging protective services, then these three types would appear to be of about equal value. Yet everyone knows this is not the case. The important consideration is not so much the commodity temperature at unloading as is the time required to reduce the temperature to a safe level of 50 degrees or lower.

Because of the higher temperatures usually prevailing at the top of the load during the transit period, that is the place in ordinary end-bunker cars where most decay develops. Thus the type of car may exert an even greater influence on the rate of cooling than the choice of protective service. The standard end-bunker car is not well suited for the heavy, non-precooled citrus loads which may extend to within two feet of the ceiling of the car. However, the end-bunker car equipped with fans under the floor rack (Preco fans) set to operate while the car is moving provides the most rapid means of cooling the top of the load while the car is in transit.

The comparative rates of cooling in standard end-bunker cars and fan cars attached to regular or "slow" and advanced or "fast" trains are shown in figure 3. In each comparison of cars the top of the load in the fan cars cooled much faster than that in standard cars-the faster the train, the more efficient the fans.

Comparisons (A), oranges in crates, and (B), oranges in 8-lb. mesh bags over one layer of wire-bound crates, were made with cars on the "slow" or regular schedule train while comparison (C), oranges in crates, was made on the "fast" or advanced schedule train. Usually the transit period to the East is shortened one day by the advanced schedule.

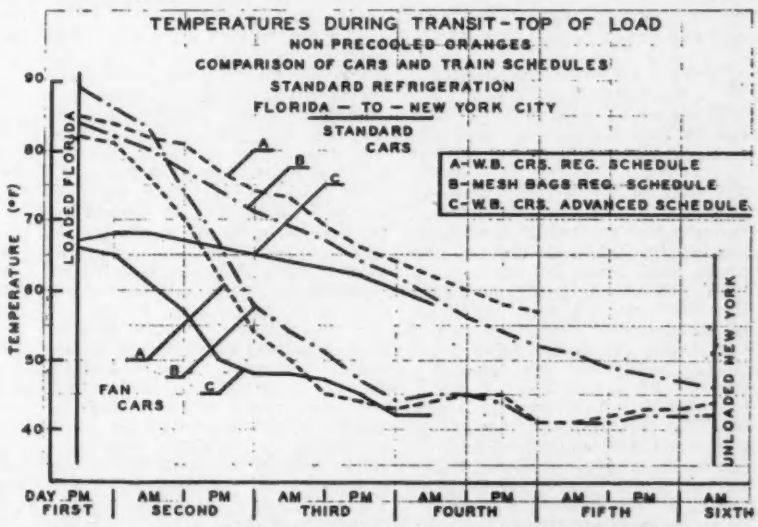


Figure 3. Temperatures during transit—top of load. Comparison of cars and train schedules.

In each comparison the commodity temperature in the fan cars was below 60 degrees before midnight of the second day, or about 30 hours after loading, whereas

(Continued on page 26)

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The LYONIZER

Department

COMPILED BY THE LYONS FERTILIZER CO.

Reports Of Our Field Men . . .

POLK COUNTY
J. M. (Jim) Sample

At this writing it is impossible to determine the amount of damage to citrus fruit caused by the recent cold spell.. We had temperatures as low as 23 degrees in some low ground areas and had fruit with ice showing until well up into the morning. With continued cool weather for some time it is generally believed that the damage to fruit will be light. We had foliage damaged on young trees and to some extent on old trees in the colder areas, but apparently there was little wood damage. We continue to move heavy volumes of fruit to both the packer and canner. The canning plants in this territory are buying oranges on an acid test as each truck load arrives at the plant. The higher the acid the better the price. We are just getting under way with our spring application of fertilizer and this will be carried through by various growers up into March.

NORTH CENTRAL FLORIDA
V. E. (Val) Bourland

The general consensus of opinion in this territory is that the orange crop will be somewhat shorter than was first anticipated, but that grapefruit will probably pick out the estimated tonnage. Oranges and grapefruit have been moving through both the packing plants and canneries at a rapid rate, and as we cover the territory we can tell that the fruit is disappearing from the trees. Tangerines, however, have been moving slowly and this has many growers in a quandary as prices have been satisfactory for those reaching the market. The recent cold spell did considerable damage to the vegetable crops in this section, killing most of the peppers and all of the tender crops. However, cabbage and other hardy leaf crops came through in good shape. Some tangerines were frozen in low cold areas, but apparently there was little damage to the well protected groves.

WEST CENTRAL FLORIDA
E. A. (Mac) McCartney

The cold weather did considerable damage to citrus fruits in this territory. I have been through Pasco, Hillsborough and Hernando Counties where I talked with growers and grove caretakers who cut fruit the first morning after the freeze and they all say that they found ice in the fruit. The extent of the damage will not be determined for several days. If the weather should continue cool for a while the loss will no doubt be less, but if it should turn off real warm no one at this time can predict just what the loss will be. There will be a heavy loss in the case of tangerines and I have been in several groves that will not be picked. Growers realize the importance of feeding their trees following the freeze to replace lost foliage and give their trees added vitality for setting a crop of fruit and are planning to get started with their spring application of fertilizer soon.

SOUTH POLK, HIGHLANDS AND HARDEE COUNTIES
R. L. (Bob) Padgett

We are moving fruit from this territory just as fast as we possibly can with not even a Sunday holiday. The canneries have established a price schedule set up on the acid content of oranges and the higher the acid the better the price. Some of the early fruit still on the tree contains so little acid that it cannot be picked at any price. There is quite a bit of talk about the movement of Valencias and it now appears that they will start moving at an early date. There are a large number of growers that sold their tangerines earlier in the season but have never had them picked. It seems that tangerines will just not carry through to market in saleable condition. This condition is causing growers a great deal of concern, and while it is probably the result of warm moist condition, there is considerable study being given this problem. The cold weather of January 15 to 16 sent temperatures down to as low as 25 degrees in this section and fruit in many sections showed ice formation.

SOUTHWEST FLORIDA
Eaves Allison

Mild weather had continued up until Jan. 15 when our first real cold snap hit us. The vegetable growers who had the courage to re-plant their acreage after the hurricane destruction have won their gamble with Jack Frost and have all made some money. However, those crops that were still growing when the cold spell hit were badly damaged and we estimate that the Ruskin area had a loss of eighty to ninety percent in the case of tomatoes, beans, eggplant and squash, with most of the seed beds saved. About the same condition exists in Palmetto area. The damage to gladioli in the Bradenton and Palmetto area was about 15 to 20 percent. There was some ice in fruit in the Bradenton and Sarasota area on the morning of the 15th. The damage was light in the Fort Myers area with only squash seriously hurt and potatoes nipped. A new blight or burn is affecting the foliage of gladioli in South Hillsborough and North Manatee Counties. What it is has not yet been determined. Further South, in Lee County, another new disease, curvelaria, has been checked either by control measures used or by the coming of cooler weather.

HILLSBOROUGH AND PINELLAS COUNTIES
C. S. (Charlie) Little

The cold weather of mid-January which sent temperatures below the freezng point did not do a great deal of damage to citrus fruits in this territory. This is especially true in the case of grapefruit and oranges, but tangerines were more severely damaged, with many crops apparently a complete loss. Vegetable crops did not get by so well and tomatoes and eggplant were just about a complete loss. Strawberries were also hard hit but with favorable weather conditions coming at an early date it is possible that growers will again be able to pick some berries. The movement of fruit has been slow in this territory. The price being received for grapefruit is low and as a result a large number of growers are holding their fruit on the trees hoping that the marketing situation will improve. Early and mid-season varieties of fruit have been of inferior quality to what we normally have and dryness has been showing in the fruit. Some crystalization has been showing in Valencia oranges.

ADVERTISEMENT — LYONS FERTILIZER COMPANY

Some of us sort of hate to admit it, but fer some reason the taste appeal of our citrus hasn't been up to par until just lately . . . maybe late bloom or fall weather conditions was responsible, but for several months we sent fruit to market that the folks up north didn't find as good as usual . . . today the situation is a heap different, both oranges and grapefruit is really dee-licious . . . but somehow or other we got to convince the customers so they'll start buyin' our fruit . . .best way we know is fer each of us growers to send a small box or package of this good fruit to some friend in the north and get 'em in the habit of demandin' this fine Florida citrus when they visit their grocer . . . urge your neighbor to do the same thing . . . it'll help everybody.

Everyone connected with the citrus industry is havin' problems . . . plenty of 'em . . . in a lot of cases growers is sellin' their fruit fer less than it costs 'em to produce it. Such a situation cannot continue over too long a period of time, but it seems that labor and certain other elements have mighty little regard for the future. The Lyons Fertilizer Company Field Force, most of 'em grove owners, has been holdin' regular meetin's to try to work out a program that will help the grower raise his fruit in the most economical manner. They have faced the fact that fertilizer is a major portion of their production costs . . . and while it is the one most essential cost, they have developed a number of ideas that'll result in savin's to the grower . . . The Lyons Field Force has always aimed to give service . . . and now they are tryin' harder 'n ever to do just that. The executive branch of the Company is wholeheartedly behind these efforts.

The reports of the Lyons Field Force on the opposite page will give you a pretty general picture of the cold damage during the recent cold weather.

The USDA has made a survey of the Leesburg area to find out if a farmer's market ought to be established there . . . if there is enough producin' acreage to do a half million dollar volume, the prospects of the market is good.

Nathan Mayo, Commissioner of the State Department of Agriculture, says crop losses in the rich farm belt southeast of Lake Okeechobee due to flood waters has been estimated at from $15,000,000 to $20,000,000 . . . from 16 to 18 thousands cars of vegetables are usually produced in this area.

Uncle Bill

COLD DAMAGE

Reports from all sections of the citrus belt indicate that the damage sustained by citrus growers from the cold of January 15 and 16 was less than might have been expected with the mercury dropping as low as it did in some areas.

Field men for fertilizer and insecticide concerns report that for the most part oranges and grapefruit came through with slight damage, due probably to the fact that cool weather continued for some days after the freeze. Tangerines, however, were seriously injured in most sections, in some groves the crop being virtually a total loss.

There was some foliage damage on young trees, but there has been no report of any serious injury to wood. Considering the severity of the weather, the citrus grove owners came through with surprisingly moderate loss.

DECAY OF FLORIDA CITRUS FRUITS AND ITS CONTROL

(Continued from page 23)

it was well into the fourth day before such temperatures were obtained in the several standard cars. This lag in cooling would be expected to result in a greater amount of decay.

The prompt and judicious use of refrigeration all the way from the packer to the comsumer is the safest procedure since it not only prolongs the life of the fruit but also preserves its true fruit flavor and appearance; nor does it introduce a health hazard to the consumer.

Before concluding, some mention should be made of the importance of speed in operations. Although the life expectancy of our harvested fruit varies from grove to grove and from month to month, it is not long at best. Therefore, it is good judgment to pick, pack, and load out or precool on the same day whenever possible. It is poor management to let fruit stay at room temperature in the packing house over weekends, as often happens, waiting to be either packed or shipped out. We may have very good reasons for our delays, but unfortunately the rot fungi do not cooperate with us. Too often the weather conditions prevailing at the time of the delay are just to the liking of the fungi, and they never fail to take full advantage of the situation.

Mann Named Vice President American Potash Institute

Dr. H. B. Mann of Atlanta, formerly Southern manager for the American Potash Institute, has been appointed vice president of the Institute. Well known throughout agricultural circles because of his past association with experiment stations and other scientific organizations, Dr. Mann assumed his new duties at the Institute headquarters in Washington, D. C., on January 1st.

All wiring on electric systems financed by the REA must be installed in accordance with the National Electrical Code.

Weevils and other insects destroy over $350,000,000 worth of grain every year in the United States.

U. S. farmers use electricity in more than 350 different ways.

Dark lamp shades absorb light. The same bulb will give 50 per cent more light with a white or ivory shade.

Man is supposed to have kept honeybees long before there was any written record of the human race

Classified Ads

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Clay Hill Nurseries Co.
Box 2880, Tampa, Fla.

CITRUS TREES for fall and spring delivery. All varieties. F. Gould Garcia, Box 843, Lakeland, Florida.

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RUBY RED GRAPEFRUIT and all standard varieties on lemon and sour stock. Grand Island Nurseries, Eustis, Florida.

FOR SALE — McCormick-Deering 04 grove tractor; completely overhauled, painted, like new; $1200. May be seen at South Florida Motor Co., Arcadia. L. N. Cline, Box 1167, Lakeland, Florida.

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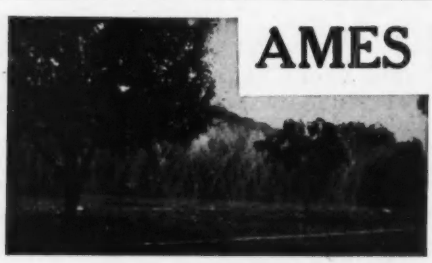

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